conference called by Admiral Mouchez, director of the Paris observatory, for the purpose of forming a plan of co-operation in photographing the whole sky. The proposition is to enlist ten or twelve observatories in the undertaking, and to obtain instruments of uniform power, so that their work may be homogeneous. If the suggestion that each plate shall be four degrees square is adopted, about 11,000 plates will be required; and, with an average of 100 plates per year from eleven observatories, it will take ten years to complete the map. It is understood that Dr. Peters of Clinton, and Mr. Rutherfurd of New York, will also attend the conference.

A VERY VALUABLE CONTRIBUTION by T. Mitchell Prudden, M.D., on bacteria in ice, and their relations to disease, with special reference to the ice-supply of New York City, appears in the *Medical record* of March 26. In a series of thirty-two biological analyses of the Croton water, as it is delivered in the city, Dr. Prudden found the lowest number of living bacteria to be 57 to the cubic centimetre; the highest, 1,950; while the average was 243. While it was at one time thought that the presence of a considerable number of living bacteria in a water was evidence of its being unfit for drinking-purposes, we have now learned that this view must be greatly modified. Bacteria are almost everywhere present, in soil, air, etc., and by far the larger proportion are, so far as we know, perfectly harmless. Their *rôle* in nature is to tear down organized bodies into their simpler constituents, a small part of these being used for their own nutrition and growth, while the larger part is given up to other organisms for their life-purposes. It still remains true, however, that a certain number of species, which can live in water as well as elsewhere, can and do produce deadly diseases, and are responsible for some of the most frightful epidemics.

Dr. Prudden made a series of experiments to test the effect of freezing on the bacteria. His method was as follows: a large number of test-tubes were plugged at the mouth with cotton, and sterilized. Into these tubes was put sterilized water mixed with a small quantity of a pure culture of some well-defined species of bacteria, the number of bacteria in one cubic centimetre of water having been previously determined. The tubes were then exposed to a temperature of from 14° to 30° F., the water becoming solid in a short time. Six different species of bacteria were thus experimented with: 1°. Bacillus prodigiosus; 2°. A short bacillus frequently found in the Hudson River water, and occasionally in the ice, apparently identical with the Proteus vulgaris of Hauser; 3°. A slender bacillus very common in Croton water; 4°. Staphylococcus pyogenes aureus, derived from a case of pyaemia; 5°. A short bacillus very common in ice all about New York, which may be designated the 'fluorescent bacillus,' from its appearance in gelatine; 6°. The bacillus of typhoid-fever. In the case of the Bacillus prodigiosus, there were 6,300 bacteria in a cubic centimetre of water before freezing; after being frozen 4 days, 2,970; after 37 days, 22; and none after 51 days. Of the Staphylococcus pyogenes aureus, there were a countless number before freezing; after 18 days of freezing, 224,598; after 54 days, 34,320; and after 66 days, 49,280: of the typhoid-fever bacillus, innumerable before freezing, 1,019,403 after being frozen 11 days, 336,457 after 27 days, 89,796 after 42 days, and 7,348 after 103 days. These experiments were repeated with practically the same results, so that it may be accepted as abundantly proven, that, after prolonged freezing, a considerable number of the typhoid bacilla remain alive.

WILLIAM BABCOCK HAZEN.

THE sudden death of Brig.-Gen. William B. Hazen, chief signal officer of the U. S. army, which occurred on Sunday, Jan. 16, 1887, deprived the country of one of its most distinguished officers, and the signal corps of a chief who took a broad view of its duties and relations to the world of business and science.

Gen. William B. Hazen was the great-grandson of Thomas Hazen, who was born in 1719, and who was himself a great-grandson of Edward Hazen, who emigrated from England before 1649, and settled at Rowley, Mass., where he died in 1683.

The descendants of Edward Hazen include many names eminent in business, theology, and war. Energy, industry, and strong convictions characterize the members of the family on all sides.

General Hazen was born at West Hartford, Vt., Sept. 27, 1830. While he was yet a child, his parents removed to Hiram, Portage county, O. In 1851 he was appointed from Ohio as a cadet to the U. S. military academy at West Point, from which he graduated July 1, 1855. He was assigned to the 8th U. S. infantry, and spent the next five

years in frontier service, more especially against the Indians in California, Oregon, and Texas, in which service he displayed an energy and bravery that have been characteristic of his life. His record during these years embraces constant fights and pursuits. He was twice severely wounded, and by virtue of his wounds, he was, in January, 1860, by the surgeon's order, granted a leave of absence as being unfit for duty. In consequence of this, he was at the north, while his regiment was in Texas, at the breaking out of the rebellion. The regiment having been captured, and its officers released on parole, he alone was unembarrassed by the parole, and was able to offer his services to the Union army. He was at once assigned as temporary instructor at West Point. In May, 1861, he became captain in the 8th infantry of the regular army, and in October was made colonel of the 41st regiment of Ohio infantry, in the volunteer army. During the war, he distinguished himself on many occasions, and his commission as major-general was granted him Dec. 13, 1864, for 'specific distinguished services;' i.e., "for long and continued services of the highest character, and for special gallantry and service at Fort McAllister." This placed him fifth in a list of twenty-four officers who had received commissions for distinguished services.

He continued serving on the frontier territories, north and west, and was especially active in Indian affairs, until 1870, in which year he was allowed leave of absence to visit the seat of war in Europe. The results of his observations and studies during his six-months' absence are embraced in a volume entitled 'The school and the army in Germany and France, with a diary of siege life at Versailles' (New York, 1872). This volume contains an interesting sketch of Bismarck, and Bismarck's own account of the state of affairs in Europe. It contains especially a fair criticism of the relative excellences of the German and French systems, both civil and military. In a special chapter on that subject, he incidentally brought out more prominently some weak points in our own military organization. It would seem that the courage displayed so brilliantly on the battle-field frequently nerved him to utter not only these but other fearless criticisms of things that were palpably wrong, and some of which have since been corrected.

He was married Feb. 15, 1871, to Millie, daughter of the Hon. Washington McLean of Cincinnati, who, with one son, survives him.

On his return from Europe in 1871, he returned to duty in the Indian Territory, and was with his regiment in Kansas and Dakota, except for a short absence, until Dec. 15, 1880, when he was by President Hayes appointed brigadier-general and chief signal officer, and has since then been stationed at Washington. The absence just referred to was occasioned by his again visiting Europe as military attaché to the U. S. legation at Vienna, for the purpose of studying the operations of European armies during the Turco-Russian war. He was absent on this service from December, 1876, to June, 1877, and the results of his observations were published subsequently in a highly interesting popular volume.

The general account of his activity during the war of the rebellion was published by him in his 'Narrative of military service' (Boston, 1885).

His letters and pamphlets on the 'Bad Lands' show that for many years General Hazen had been studying the relations of meteorology and agriculture. Upon his appointment as chief signal officer, he became indefatigable in his efforts to improve the military and departmental relations of the signal service, its scientific character, its practical usefulness to farmers and herders, and its popular influence. His labors in Washington stirred up most virulent opponents, — first, when it became necessary for him to expose and prosecute the corruption of Captain Howgate; again, when it became necessary, in self-defence, to expose the true reasons of the failure of the war department to properly support and succor the signal-service expedition to Fort Conger; and again, when he had occasion to defend the advantages of the military character of the combined signal-service and weather-bureau organization against those who would take it from the army without making a proper provision for its work in any other department. The records of his successful defence against attacks prompted by implacable hate, official stubbornness, and personal ignorance, are to be found in the Proceedings of courts-martial, courts of inquiry, committee of congress on expenditure, and especially in the 'Testimony before the joint commission to consider the present organization of the signal service,' etc., which last voluminous report, with testimony, was printed in June, 1886.

General Hazen's interest in meteorology, as before said, properly dates back earlier than 1873, at which time he prepared a letter on 'Our barren lands, or the interior of the United States west of the 100th meridian and east of the Sierra Nevadas.' This was published in the New York *Tribune*, Feb. 27, 1874, and led to a discussion in that paper, and in the Minneapolis *Tribune*, between himself and Gen. A. A. Custer, which is summarized in a pamphlet of the above title published by Robert Clarke & Co. of Cincinnati, in 1875. The motive of General Hazen evidently was the protection of

investors and settlers against the too glowing accounts, which amounted to virtual misrepresentation, on the part of the employees of the Northern Pacific railroad. His compilation of climatological data, and his statement of personal experience based on long residence in that region, largely contributed to prevent blind emigration into an inhospitable country, while they doubtless also contributed to direct attention to the really valuable portions of our north-west territory, so that the permanent development of that portion of the United States has been furthered by his action. It was, however, at the time, on his part a very characteristic, outspoken exposition of what seemed to him a fraud and imposition, perpetrated by unscrupulous financiers upon foreign immigrants and over-confiding settlers and investors.

During his connection with the signal office, General Hazen frequently took occasion to show his appreciation of the fact that the weather-predictions were essentially not a matter of mere military routine, but that in all departments the office had need of the work of specially trained experts; that it was a mistake to shut one's eyes to the fact that in a matter of applied science, like this, some of those whom the scientific world recognizes as meteorologists and physicists must be employed, and be required to keep the chief fully informed of the progress of science. Perhaps this is best exemplified by a quotation from his letter of March 24, 1886, addressed to a committee of the house, on expenditures of the war department: "At the beginning of the work of the signal service, the duty of giving notice of the approach and force of storms and floods, for the benefit of commerce and agriculture throughout the United States, implied that the notices should be correct, reliable, and timely, as none others could possibly be of benefit; it was therefore absolutely necessary to provide for the careful study of the atmosphere. On my accession, I found every evidence from popular criticism that still further progress in weather-predictions was expected. I therefore emphasized especially the necessity of the study of the instruments and methods of observing, and the investigation of the laws of the changes going on in the atmosphere. . . . It is evident by these successive steps, that, in addition to knowledge gained for current work, the office is powerfully contributing towards the establishment of a deductive science of meteorology, which will eventually give us a solid, rational basis for predictions, thereby improving on the empirical rules by which predictions have generally been made hitherto." And he adds that he was led more especially to assist in the researches on the sun's heat by reason of the encouragement given him by the late President Garfield, whose "last words to me were, 'Give both hands of fellowship and aid to scientific men.'"

As a further illustration of General Hazen's appreciation of the scientific needs of the office, must be noted his appointment of Prof. William Ferrel as meteorologist, and of Prof. T. C. Mendenhall as electrician: to the latter, all matters relating to standards, instruments, and instrumental research were also committed. Nor did he stop here, but, by appointing several younger men to positions as junior professors, he largely increased the amount of study and research that the office was able to perform; and by publishing a series of professional papers and smaller notes, he took the final steps necessary to stimulate every man to do his best.

Laboring in this same direction, he sought to elevate the intelligence and scientific training of the signal corps proper, by enlisting college graduates as far as possible, by extending the course of instruction for observers, and by establishing a course of higher instruction for commissioned officers.

In still another direction General Hazen showed his affiliation with scientific interests; namely, by his desire to conform as thoroughly as possible to the recommendations of the international meteorological conferences. These recommendations, as soon as received in the printed minutes of the conferences, were, by General Hazen's orders, carefully examined, and instructions at once prepared calculated to introduce methods of observation and publication in conformity with the recommendations of the leading meteorologists of the world.

Among the items specially noteworthy, wherein General Hazen developed new paths of activity for this service, may be mentioned the study of local thunder-storms and tornadoes, which were assigned respectively to Prof. H. A. Hazen and Lieut. J. P. Finley so far as a collection of general statistics is concerned, and to Professor Mendenhall so far as concerns the electrical phenomena proper. The study of atmospheric electricity was especially authorized in 1884, by an order of the secretary of war, transmitting the resolutions of the international electrical conference held in Paris the preceding year. After full consultations with numerous electricians throughout the country, General Hazen decided that a daily map of electric potential, showing lines of equipotential, similar to the isobarometric lines, offered hopeful prospect of leading eventually to a method of predicting the formation and motion of thunder-storms and tornadoes. But the methods of observation and the apparatus

needed first to be determined upon, after careful experimental work. This whole matter was therefore, in 1885, committed to the hands of Professor Mendenhall.

Perhaps the most important item in internal administration, so far as it affects the permanent scientific value of the office-work, was the effort, heartily furthered by General Hazen, to improve the accuracy and international comparability of our instrumental equipment. The standards of the International bureau of weights and measures were recognized by him as being the proper legal standards for this office, and every effort was made to determine the corrections needed to reduce the past as well as the current meteorological observations of the signal service to agree therewith.

Perhaps the generous breadth of General Hazen's views, the absence of injurious jealousies, and his confidence in the principle that the weather-bureau would be strengthened by the widest diffusion of an intelligent appreciation of meteorology, are in nothing more clearly shown than in the earnestness with which he stimulated the formation of state weather-services, and encouraged the study of meteorology in every school and college. He was painfully impressed by the disastrous influence upon individuals and business of the wide-spread and utterly absurd predictions of the storms and weather of the 9th of March, 1884, which emanated from Mr. Vennor, and were distributed broadcast through the country. He saw clearly that all this harm could be prevented only by increasing the intelligence of the people in scientific matters, and heartily indorsed every effort to diffuse a more correct idea as to what constituted legitimate meteorology.

Although his duties demanded the maintenance of a great central office at Washington, yet General Hazen realized that centralization could easily be carried too far in scientific matters, and would thus react injuriously upon the work of his office. He was desirous of rapid progress in all directions, and, to secure this, welcomed every prospect of co-operation with other institutions as well as with individuals. One of his first acts was the request for co-operation on the part of the National academy of sciences. He improved the opportunity to help Professor Langley in the determination of the absorbing-power of the atmosphere; he accepted Professor King's offer to carry observers on his balloon voyages; he heartily furthered Lieutenant Greely's efforts to maintain an international polar station, and joined with the coast survey in establishing a similar station, under Lieutenant Ray, at the northern point of Alaska; he co-operated with the bureau of navigation in securing weather-reports from the ocean; he powerfully assisted the metrological society in its labors for the reformation of our complicated system of local times, the result of which was the adoption by the country of the present simple system of standard meridians one hour apart.

Equally successful was he in his efforts to co-operate in various methods of disseminating and utilizing the knowledge obtained by the weather-bureau for the benefit of the business interests of the country. With the telegraph companies he published the daily telegraph bulletin. Through the railroad companies he displayed the railroad train signals, visible to every farmer along the railroads. With local boards of trade and other business interests he elaborated our system of flood-warnings in the river-valleys.

General Hazen was especially clear in his views as to the importance of giving personal credit to each man for his own personal work. Routine work was credited to the assistants in charge, and not to the impersonal office. Having assigned a special work to the best man available, he took pains to give him the credit, and make him personally responsible for its success, thus securing more enthusiasm in the work.

This notice of a few prominent features in the intense activity of General Hazen's life seems eulogistic rather than historical; but, to the contrary, the fact is, that military life rarely offers a position that requires the promotion of any special science, and still more rarely do official or military circles present an officer who so thoroughly desired, as far as allowable, to relax stringent military law, and liberally interpret cumbersome official regulations, so that scientific men might successfully promote their special work.

Cleveland Abbe.

ETHNOLOGICAL NOTES.

The Proceedings of the U. S. national museum, for 1886, contain a paper by George H. Boehmer on Norsk naval architecture. He compares the modern Northland boat, which is in use along the coast of Norway, round the North Cape to the frontier of Russia, with the ancient Norsk boat. In this boat he recognizes the oldest forms known. These are known from the rock sculptures discovered in Sweden and Norway, which are supposed to have been made from five to eight hundred years before the Christian era; from boat-shaped stone burial-groups, supposed to have been erected during the transition time from the bronze period to the iron age, in Scandinavia; and from boat-remains. The boat is long, narrow, and low, with stem and stern posts alike, both being curved and high. The rowlocks of these boats bear an oblique pro-